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The Relationship Between Team Role Sub-dimensions, Personality, and Team Effectiveness

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THE RELATIONSHIP BETWEEN TEAM ROLE SUB-DIMENSIONS, PERSONALITY, AND TEAM EFFECTIVENESS

by

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ABSTRACT

A manned mission to Mars would be the longest manned mission (both by distance and duration) to date by a considerable margin. Such a mission poses a unique set of challenges to astronaut teams, including extreme levels of isolation and confinement never before experienced by Earth-bound teams. A crucial step in ensuring the team will arrive back on Earth safely is selecting those individuals who are most apt for the job. To facilitate the selection process and development of countermeasures, this work (as part of a larger NASA research grant) involves examining the relationship between personality (Big 5; openness, conscientiousness, extraversion, agreeableness, emotional stability) and the team role sub-dimensions, which are defined as patterns of behavior which comprise team roles, of sociability, task orientation, and dominance. Additionally, I will also examine to what extent enacting team roles (e.g., 'Critic', 'Entertainer', 'Team Player', etc.) ensures mission success, such that more effective teams will distribute team roles as needed. The data for this project was derived from NASA's HERA (Human Exploration Research Analog), a study environment meant to simulate long-duration space exploration missions. In addition to presenting hypotheses and data analyses, implications and future steps will also be addressed.

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CHAPTER ONE: INTRODUCTION & PURPOSE

Teams

It is commonly accepted that teams (consisting of as few as two members) have a common goal or purpose driving them, work interdependently to achieve their goal or purpose, and can adapt to challenges and adversity along the way (Salas et al., 1992). Cannon-Bowers and Bowers (2010) make similar assertions when defining teams in that they have a meaningful goal toward which to strive and are interdependent in their actions. Ideally, the construction of teams is to bring together unique individuals with varying knowledge, skills, and abilities. The best teams can coordinate their efforts to not only perform more efficiently, but even perform some tasks that might be impossible for a single individual. The unique circumstances of today's society necessitate the use of teams, with their unique blend of characteristics that enable them to solve any number of problems, resulting in a widespread increase in the use of teams in many organizations (Hernandez, 2002).

The concept of working on a team has gained considerable interest within organizations over the past decade, with at least one half of organizations based in the United States utilizing some form of teams (Devine et al., 1999). Modern organizations are constantly changing and evolving, presenting employees with new challenges every day and rendering the increase in the use of teams appropriate as teams possess a diverse collection of knowledge, skills, and abilities necessary to tackle the increasingly complex problems with which they are presented. As an extension of this, teams with the proper combination of members with requisite levels of knowledge, skills, and abilities will have a better work experience and perform at higher levels than teams with inferior compositions (Bell, 2007; Ilgen, 2005). In addition to members varying across many dimensions, they also vary in the functions they perform within a team. Decades of

research into team roles asserts that members of a team enact specific roles that may facilitate or hinder group functioning in some way. Typically divided into "task" and "social" categories, team roles are being looked at more in-depth as the increase in the use of teams, particularly in extreme environments, has prompted a more thorough examination of which team roles exist and how they function. Further work into team roles has identified various dimensions, with varying levels of each dimension manifesting as the roles themselves (e.g., Bales, 1950; Driskell et al., 2017). This allows for a compositional analysis of roles to be conducted akin to typical personality testing whereby role "profiles" can be developed through which it may be determined who on a team is likely to enact certain roles. With the ultimate goal of making better decisions when selecting astronaut teams, a consideration of the impact of team roles is one of many steps in ensuring a team has no gaps in functioning.

Team Roles in Space

Outer space has coined the moniker "The Final Frontier" for good reason as it presents one of the most technically challenging and extreme environments known to humans. At the forefront of exploration into this domain is the National Aeronautics and Space Administration (NASA) with the ambition of making a manned trip to Mars and back within the next thirty years. This is a particularly daunting task as the crew chosen for the mission will have to endure physical and mental stressors such as cramped living conditions, busy schedules, a restricted diet, delays in communication and many other issues for a duration no shorter than two and a half years. This is where knowledge of team roles comes into play; knowing what roles are present and most crucial for mission success enables the selection of such individuals who would naturally perform those role functions. However, the majority of current team roles research is

conducted on teams in "standard" settings such as organizations. As such, the current effort begins with an examination of what it means to be effective in team settings analogous to spaceflight. As the focus of this thesis is on team roles, and though the literature has identified myriad antecedents to team effectiveness, team role distribution will be analyzed to determine the degree to which the distribution of team task and social roles are related to team effectiveness.

Additionally, the Big 5 facets of personality will be analyzed as predictors of the role dimensions identified by Driskell et al. (2017). The Big 5 personality facets of openness to experience, conscientiousness, extraversion, agreeableness, and emotional stability are widely known and generally accepted to comprise each individual's personality profile, as evidenced by many researchers making use of the Big 5 in their studies (e.g., Curtis, Windsor, & Soubelet, 2015; Wolfe & Johnson, 1995). Testing this relationship would add another useful and informative layer to the rigorous process of astronaut recruiting. As a first step toward developing role profiles based on personality, the relationship between the Big 5 personality facets and the role dimensions examined in the work of Driskell et al. (2017; Table 1), which lays out a framework where roles are comprised of three distinct behavioral dimensions: sociability, task orientation, and dominance will also be tested.

Table 1: Driskell et al.'s (2015) behavioral descriptors for each team role dimension

High Task Orientation	Low Task Orientation	High Sociability	Low Sociability	High Dominance	Low Dominance
Achievement-oriented, organized, reliable, dependable, conscientious, planful, responsible, serious	Careless, irresponsible, disordered, impulsive, spontaneous, untrustworthy, inactive, work-shy	Friendly, interested in others, cordial, warm, gregarious, supportive	Withdrawn, aloof, avoids contact with others, prefers working alone, solitary	Dominate, control, direct, influence, assert, take charge, lead, command, active	Defer, comply, follow, compliant, submissive, support, take orders, passive

CHAPTER TWO: THEORETICAL FRAMEWORK

Team Roles

Role Theory, originally stemming from social psychology, posits that individuals performing any action, from the most extreme to the truly mundane, enact any number of social categories classified as "roles" (e.g., Friend, Student, Brother, Father, Leader, etc.). As such, the individual may enact multiple roles simultaneously in addition to being able to change roles as needed, similar to an actor. Generally, people do not behave truly randomly; we are expected to behave or act a certain way given particular situations. Thus, the behaviors that comprise any given role are a function of the expectations others have about how one should act in a given situation. On a team, this takes the form of the repetitive activities and behaviors characteristic of roles (Stewart, Fulmer, & Barrick, 2005). At the basic level, a "role" can be defined as a set of behaviors with a specific function engaged in by an individual (Stewart, Fulmer, & Barrick, 2005). As an extension of this, *team* roles refer to those behaviors and activities which pertain to one's membership responsibilities on the team. Over the years, various taxonomies have been developed (e.g., Benne & Sheats, 1948; Bales, 1950; Mathieu et al., 2015.) in order to capture all possible behaviors and actions in which team members must perform in order to accomplish their shared objectives. Similar behaviors which cluster together are typically defined as roles, and teams which have a balanced distribution of roles typically perform better than teams that do not (e.g., Senior, 1997; van de Water, Ahaus, & Rozier, 2008). For example, individuals who infuse humor and/or artistic expression into their functioning within the team would be considered to be enacting the *entertainer* role, or an individual who acts as a liaison to entities outside the team would be enacting the *boundary spanner* role. Thus, knowledge of team roles is critical as they represent interdependent behavioral patterns in pursuit of the team's goals. Knowing which team

roles are most effective in extreme environments is a crucial step toward interplanetary travel, as well-constructed crews will be the most adept in the context of long duration spaceflight. Part of this process involves being able to select individuals who can work together and may fill any gaps in necessary team functions. The following is a summary of some prominent role taxonomies and their contributions to the study of team roles.

Past Taxonomies & Contributions

One of the first publications examining team roles is that of Benne and Sheats (1948). This seminal work on group roles was derived in conjunction with the First National Training Laboratory in Group Development (Butterworth, Ephraim, & Herrold, 1947) whereby group participation functions were coded, leading to the emergence of three overarching role categories of: 1) Group Task roles, pertaining to functions related to the task which the group is deciding to undertake or has undertaken, 2) Group Building and Maintenance roles, which reflect an orientation toward promoting the functioning of the group as a group, and 3) Individual roles, whereby satisfaction of each individual group member's needs are fulfilled, which may or may not apply to the group task or functioning of the group (Benne & Sheats, 1948). The taxonomy developed was comprised of 12 task roles, 7 group building and maintenance roles, and 8 individual roles (Table 2). This work was influential in our understanding of roles in that it was the first to make the distinction between task and social roles, the foundation upon which most subsequent taxonomies were developed. While studies have been conducted confirming the emergence of these roles in small groups (e.g., Deutsch, 1949; Driver & Hunsaker, 1972), it did not quite assess the underlying behaviors of these group functions (Mudrack & Farrell, 1995). Attempting to bridge the divide between role enactment and role behavior was the work of Bales

(1950) who examined role behavior through interaction process analysis whereby observers "record the source and target of every expressive act and classify the acts" (Bales, 1950). The study resulted in the development of twelve distinct roles, 6 positive and 6 negative, across overarching Task and Social role categories (Table 3). While conceptually criticized (e.g., McGrath, 1984; Hirokawa, 1982), this work was influential in our understanding of roles as the taxonomy was derived by analyzing characteristics of behavioral patterns indicative of the team roles.

Table 2: Benne and Sheats's (1948) Functional Roles of Group Members

Group Task Roles	Group Building and Maintenance Roles	Individual Roles
Initiator-Contributor Proposes new ideas to the group or a changed way of regarding the group problem or goal	Encourager Praises, agrees with, and accepts the contributions of others	Aggressor Deflates status of others, expresses disapproval, attacks the groups, jokes aggressively
Information Seeker Asks for clarification of suggestions made in terms of factual accuracy and facts pertinent to the problem	Harmonizer Mediates the differences between other members and attempts to reconcile disagreements	Blocker Tends to be negativistic and stubbornly resistant, disagreeing and opposing without or beyond reason
Opinion Seeker Asks not primarily for the facts of the case, but for a clarification of the values pertinent to what the group is undertaking	Compromiser Operates from within a conflict in which their idea or position is involved	Recognition-Seeker Tries to call attention to themselves through boasting or reporting their achievements
Information Giver Offers facts or generalizations which are authoritative or relates their own experience pertinently to the group problem	Gate-Keeper Attempts to keep communication channels open by encouraging or facilitating the participation of others	Self-Confessor Uses the audience opportunity which the group setting provides to express personal feelings, insight, and ideology
Opinion Giver States their belief or opinion pertinently to a suggestion made or to alternative suggestions	Standard Setter Expresses standards for the group to attempt to achieve in its functioning	Playboy Makes a display of their lack of involvement in the group's processes
Elaborator Spells out suggestions in terms of examples or developed meanings and tries to deduce how an idea or suggestion would work if accepted by the group	Group-Observer Keeps records of various aspects of group process and feeds such data with interpretations into the group's evaluation of its own procedures	Dominator Tries to assert authority or superiority in manipulating the group or certain members of the group
Coordinator Shows or clarifies the relationships among various ideas and suggestions, tries to coordinate activities	Follower Goes along with the movement of the group, generally accepts the ideas of others	Help-Seeker Attempts to call forth a sympathetic response from other group members
Orienter Defines the position of the group with respect to is goals		Special Interest Pleader Cloaks prejudices or biases in the stereotype which best fits their needs
Evaluator-Critic Subjects the accomplishment of the group to some standard or set of standards of group functioning in the context of the group task		
Energizer Prods the group to action or decision		
Procedural Technician Expedites group movement by doing things for the group		
Recorder Writes down suggestions and makes records of group discussion and decisions		

Table 3: Bales's (1950) Categories for the analysis of small group interaction

Social-Emotional Roles		Task Roles	
Positive	**Negative**	**Questions**	**Answers**
Shows Solidarity Raises other's status, gives help, rewards	Shows Antagonism Deflates other's status, defends or asserts self	Asks for Orientation Information, repetition, confirmation	Gives Orientation Information, repeats, clarifies, confirms
Shows Tension Release Jokes, laughs, shows satisfaction	Shows Tension Asks for help, withdraws out of field	Asks for Opinion Evaluation, analysis, expression of feeling	Gives Opinion Evaluation, analysis, expresses feeling, wish
Agrees Shows passive acceptance, understands, concurs, complies	Disagrees Shows passive rejection, formality, withholds help	Asks for Suggestion Direction, possible ways of action	Gives Suggestion Direction, implying autonomy for other

Another influential piece of roles literature comes from the work of Mumford, Campion, and Morgeson (2006). This work sought to consolidate the disparate role taxonomies into a more comprehensive taxonomy. They examined over 120 different team member roles identified throughout the literature. Then, they utilized Q-sort methodology, whereby raters compare ideas in relation to other ideas (in this case, roles), to arrive at a taxonomy of 10 roles with three overarching categories: Task roles, Social roles, and Boundary-Spanning roles (Table 4). Additionally, Mumford, Van Iddekinge, Morgeson, and Campion (2008) sought to validate the previously mentioned taxonomy and use team role knowledge as a predictor for overall team success with positive results. This taxonomy is unique in that it was one of the first to consider how teams might interact with external entities (e.g., other teams or an authoritative power), and the behaviors associated with those interactions. The last taxonomy that will be briefly reviewed belongs to Mathieu et al. (2015). This model posited that individuals will enact behavioral patterns indicative of roles based on life experiences and orientations toward various stimuli. The focus of the model was on these "orientations" which they intended to reflect personality or other individual differences. The methodology used to derive the taxonomy is similar to that of Mumford et al.'s (2006) in that existing role taxonomies were examined with six overarching

categories distilled from them (Table 5). The authors then created a survey measuring team members' role-related behaviors which was found to be psychometrically sound (i.e., $r = .70$, $p < .001$ across all items). This work is significant in our understanding of team roles in that its focus is on behaviors which are indicative of roles themselves. It is with a similar focus through which subsequent hypotheses in this work will be analyzed.

Table 4: Mumford et al.'s (2006) Team Role Typology

Role	Definition
Contractor	Behaviors that function to structure the task-oriented behaviors of other team members
Creator	Behaviors that function to change or give original structure to the task processes and strategies of the team
Contributor	Behaviors that function to contribute critical information or expertise to the team
Completer	Behaviors that function to execute the individual-oriented tasks within the team
Critic	Behaviors related to going against the "flow" of the team
Cooperator	Behaviors that function to conform to the expectations, assignments, and influence attempts of other team members, the team in general, or constituents to the team
Communicator	Behaviors that function to create a social environment that is conductive to collaboration
Calibrator	Behaviors that function to observe the team social processes, to make the team aware of them, and to suggest changes to these processes that would bring them in line with functional social norms
Consul	Behaviors that involve interactions taking place primarily outside the team setting that function to collect information and resources from relevant parties in the organization
Coordinator	Behaviors that involve interactions taking place primarily outside the team setting and coordinating with other parties

Table 5: Mathieu et al.'s (2015) Team Role Experience and Orientation dimensions

Role	Definition
Organizer	Someone who acts to structure what the team is doing; keeps track of accomplishments and how the team is progressing relative to goals and timelines
Doer	Someone who willingly takes on work and gets things done; can be counted on to complete work, meet deadlines, and take on tasks to ensure the team's success
Challenger	Someone who will push the team to explore all aspects of a situation and to consider alternative assumptions, explanations, and solutions; comfortable debating and critiquing
Innovator	Someone who regularly generates new and creative ideas, strategies, and approaches for how the team can handle various situations and challenges; often offers original and imaginative suggestions
Team Builder	Someone who helps establish norms, supports decisions, and maintains a positive work atmosphere within the team; calms members when they are stressed, and motivates them when they are down
Connector	Someone who helps bridge and connect the team with people, groups, or other stakeholders outside the team; ensures good working relationships between the team and "outsiders"

While there is no one universally agreed upon taxonomy, there are some common themes among them. Almost every role taxonomy in the literature represents a distinction between task- and social-oriented roles. Some taxonomies include additional categories (e.g., Individual roles, Boundary-Spanning roles), but every taxonomy consists of at least both task and social role categories. Additionally, there is a strong emphasis on understanding the behavioral dimensions which comprise team roles. This is evidenced in the work of Bales (1950) and Mathieu et al. (2015) mentioned previously in addition to others (e.g., Couch & Carter, 1952; Mudrack & Farrell, 1995). By far the most frequently occurring dimensions are those of sociability (characterized by group acceptance, friendliness, supportive, etc.), task orientation (characterized by organization, responsibility, conscientiousness, etc.), and dominance (characterized by individual prominence, authoritarianism, aggressiveness, etc.). This is evidenced in the work of Couch (1960) which found that out of 55 team behaviors measures, they all consisted of a similar factor structure of interpersonal affect (i.e., sociability), task serious versus social expressivity (i.e., task orientation), and interpersonal dominance (i.e., dominance). Bales (2001) explored role dimensions further by positing that there are three main problems that every team must face:

likability (i.e., managing positive relations), task ability (i.e., facilitating effort toward task completion), and activity (i.e., managing dominance and exerting power). It stands to reason that teams faced with problems of sociability, task orientation, and dominance would have to enact the behaviors in order to succeed. It is through the lens of the role dimensions of sociability, task orientation, and dominance identified by Couch and Carter (1952) that subsequent hypotheses will be developed using the role taxonomy found in Mumford et al. (2008).

Knowing the structure of team roles can be instrumental in the construction of teams, with many researchers developing team role taxonomies for that very reason (e.g., Driskell, Salas, & Hogan, 1987; Belbin, 1993). However, is knowledge of team roles enough to compose effective teams? Mumford et al. (2008) sought to answer this question by testing team role knowledge as an antecedent to team effectiveness by developing the Team Role Test to examine role behavior and how those behaviors effect role enactment. Given the unique nature of spaceflight teams, it may be necessary to look at other criteria in determining how roles make teams more or less effective.

Team Effectiveness

A key aspect of teams is defining what makes the team effective. However, the broader literature reveals many conceptualizations of team effectiveness. Hackman's (1987) model identifies subjective judgments of reviewers, team member satisfaction with group outcomes, and the group's ability to work together in the future as indicators of team effectiveness. A slightly different view is asserted by Cohen (1994) who claimed three separate categories comprise team effectiveness including team performance, team members' attitudes about quality of work life, and withdrawal behaviors. Another prominent model comes from Gladstein (1984),

which takes into consideration the dynamics between group inputs, processes, and outputs. This model examines groups at the group level and organizational level (inputs, e.g., structure and composition), mediated by the group's processes (e.g., communication and conflict), to arrive at group effectiveness (outputs, e.g., performance and satisfaction). Additionally, a model developed by Tannenbaum, Beard, and Salas (1992) was one of the first to consolidate prominent team effectiveness models into an integrative framework. While their model is more complex than most, taking into account task, work, individual, and team characteristics, it has a similar structure as other team effectiveness models in that team inputs are mediated by team processes to arrive at team outputs. Some other identified characteristics of effective teams include, but are not limited to, investment in positive relationships with other team members (Lawford, 2003), productivity, quality, and well-being (Church, 1998), and antecedents to team effectiveness such as trust, respect, and support (Dale et al., 2007). Despite the various conceptualizations of team effectiveness, it would be generally agreed upon that team effectiveness is a value judgment that is influenced by many factors (Salas et al., 2007), especially regarding the context, type, and quality of team member interaction.

Role Distribution

Given the unique work environment posed to astronauts (i.e., isolation, confinement, danger, no chance to escape), it may be useful to analyze more unique antecedents to team effectiveness. One approach argued by Stempfle et al. (2001) is to look at how team members distribute role responsibilities across the team, such that individuals enact those roles they are best suited to perform, and all roles are filled as necessary. A study conducted by Partington and Harris (1999) found no direct link between role distribution and performance, due largely in part

to the inherent complexity of teams. However, the data did show that a presence or absence of some roles could positively or negatively impact team performance. The presence and absence of roles would naturally be exacerbated in the context of spaceflight, necessitating an appropriate distribution of team roles such that all critical functions are being performed.

The distribution of team roles leading to more effective teams is a concept similar to that of shared leadership, such that teams whereby leadership responsibilities are distributed among team members (rather than the focus being on a designated leader) are more effective (e.g., Carson, Tesluk, & Marrone, 2007; Ensley, Hmielesky, & Pearce, 2006). Shared leadership functions in such a way that overwhelming workloads are absorbed and spread throughout the team, taking advantage of differential member expertise to solve problems as effectively and efficiently as possible. It stands to reason that team role distribution would function in a similar manner, that as scenarios demand, individuals with the requisite expertise will take charge of the situation and lessen the burden of other team members to act accordingly. With team roles being the primary driver of this effort, team role distribution will be examined as an antecedent to team effectiveness.

Hypothesis 1: Team role distribution will be positively related to team effectiveness.

While it is crucial to examine the effect of the enactment of team roles on overall team effectiveness, the next step is to examine conditions which may facilitate the enactment of team roles. In doing so, personality will be examined as a predictor of the enactment of role sub-dimensions to determine one's propensity for enacting particular roles.

Personality

Personality should be of great interest in the study of work and teams, as its various facets have been linked to work-related outcomes such as job performance and training proficiency (Barrick & Mount, 1991). Personality can broadly be described as "the relatively enduring styles of thinking, feeling, and acting that characterize an individual" (Costa & McCrae, 1995). However, broad definitions of personality do not account for the quirks and nuances of each unique individual. This has prompted researchers to begin studying, defining, and developing taxonomies in an attempt to capture the essence of what makes up an individual via their personality. Decades of research has generated numerous theories, but personality research is finally approaching a taxonomy of traits that has researchers approaching consensus (John & Srivastava, 1999) in the form of the Big Five personality inventory (Costa & McCrae, 1992).

The Big Five personality traits developed by Costa and McCrae (1992) define the five distinct traits of openness to experience (intellectually stimulating & innovative), conscientiousness (dependable & achievement-oriented), extraversion (outgoing & energetic), agreeableness (friendly & cooperative), and neuroticism (emotionally unstable). The five-factor model is advantageous over some other models as it can be measured through self-reports and ratings made by others (McCrae & Costa, 1987). Additional work has been conducted linking the Big Five personality traits to performance criteria across a variety of career fields. For example, Barrick and Mount's (1991) comprehensive meta-analysis examining the link between the Big Five personality constructs and measures of performance, including job proficiency and training proficiency, found conscientiousness to be a significant, consistently valid predictor across all measures of performance examined within the meta-analysis. Their study also found extraversion

and openness to experience to be effective predictors of training proficiency, further solidifying the Big Five traits to be predictive of performance in job settings. Similar findings were echoed in the work of Hurtz and Donovan (2000) who found conscientiousness to have the highest validity in predicting job performance. Additionally, they found emotional stability and agreeableness to have decent validities in predicting performance for interpersonal roles, such as customer service, sales, and managerial jobs. Given the extensive testing and use of the Big 5 personality dimensions in the workplace, it makes the most sense to use the dimensions in predicting role behavior enactment, as will be tested in the following hypotheses.

This project takes into consideration the intersection of the role dimensions of sociability, task orientation, and dominance (Couch & Carter, 1952) and the personality constructs that comprise the Big Five (i.e., openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism). Given the impact of team roles on team outcomes, the next step for the purposes of this thesis is to determine how each personality construct is related to the prominent behavioral dimensions, giving insight into how certain personality traits can be indicative of a propensity to enact certain team roles.

Openness to Experience

The personality trait of openness to experience characterizes an individual as intellectually stimulating, innovative, and creative (Zhao & Seibert, 2006). People who are open to experience are more curious and cognizant of their feelings and emotions. These people would naturally draw people toward them with their status as an intellect or person of culture, as could be inferred from numerous studies that consistently find openness to experience to be correlated with extraversion (Lopes et al., 2006; Scotter et al., 2011). Individuals who are open to

experience have a certain gregariousness about them, preferring to be around people exchanging intellectual ideas. This is perfectly in line with facets of sociability such as being friendly, interested in others, and cordial.

The preferred cognitive style of open individuals is nested in the abstract, i.e., they thrive in intellectually stimulating environments where they can think creatively. Barrick and Mount (1991) found that being more open is positively correlated with training proficiency. This is reflected in the findings of Le Pine, Colquitt, and Erez (2000) which found that people who are more open have an increased willingness to engage in learning. It has even been found that openness is positively related to motivation in pursuing goals (Vaughn, Baumann, & Klemann, 2008). These individuals would be more likely to reflect on their process and experiences and critically evaluate them. Their desire to improve would facilitate the completion of tasks required of the team. Particularly relevant task orientation descriptors for openness would be those of planful and achievement-oriented.

There is nothing about the characteristics of people who are open to experience that indicates that they would inordinately desire power and control. Interestingly, nothing about having low dominance, indicated by being aloof, deferring to, and avoiding others, is inherent to the various characteristics that comprise openness. This was demonstrated by Scotter et al., (2011), which found the effects of being open to experience almost inconsequential on task dominance. There is no reason to believe that open individuals will be excessively dominant or compliant.

Hypothesis 2: Openness to experience will be positively related with sociability and task orientation.

Conscientiousness

The title of the most well-known and exhaustively researched personality construct undeniably belongs to conscientiousness. Across countless studies conducted, among the most common conclusions is that of the Big 5 personality constructs, conscientiousness has the strongest connection with individual performance at work, while also being generalizable across jobs (Barrick & Mount, 1991; Mount & Barrick, 1995). Some common characteristics used to describe conscientious individuals include industrious, dependable, and achievement-oriented (Zhao & Seibert, 2006). Of mention regarding sociability is the aspect of dependability. Team members who are dependable are cautious, reliable, and thorough (Le Pine et al, 2000; Ciaverella et al., 2004). It stands to reason that individuals who are dependable would also be supportive, gregarious, and well-liked by others. Demonstrating this assertion is the research conducted by Barrick et al. (1998) which found that teams without very low-conscientious members reported less conflict and increased communication.

As conscientiousness can largely be generalizable across jobs and tasks, teams possessing members with increased conscientiousness are more likely to help each other and contribute more to team outcomes regardless of a team member's specific role, tasks, or relationship with other members (Barrick et al., 1998). As a team's overall conscientiousness increases, so too would its performance. This relationship exists because conscientious individuals possess higher than average levels of achievement orientation. Team members who are highly motivated to achieve are more concerned about the success and outcomes of the team (Zander & Forward, 1968), they are better performers (Barrick et al., 1998), and they are more efficient workers (Schneider & Delaney, 1972).

The interaction between conscientiousness and dominance has been researched to a much lesser extent. In situations where a team possesses one or more low-conscientious individuals who neglect their duties, Barrick et al. (1998) found that high-conscientious team members will attempt to compensate for the low-conscientious members' lack of effort. In addition to completing their own duties, high-conscientious team members often complete the work of low-conscientious team members, leading to an overall decrease in team performance; instead of "taking charge" and "controlling" the situation by requesting and/or demanding that the low-conscientious members fulfill their role obligations, an individual high in conscientiousness will most likely assist rather than dominate.

Hypothesis 3: Conscientiousness will be positively related with sociability and task orientation, and negatively with dominance.

Extraversion

The personality trait of extraversion characterizes individuals who are outgoing, affable, energetic, and optimistic. Extroverts enjoy interacting with other people and thus, would be more motivated to engage in behaviors that will help sustain their team (Barrick et al., 1998). These traits have been shown to facilitate positive team interaction and collaboration (Zhao & Seibert, 2006; Ciavarella et al., 2004). Individuals high in extraversion usually provide social support through showing appreciation and encouraging other team members (Carson et al., 2007).

There is nothing about extraversion that would lend to the line of thinking that extraverts are high or severely lacking in task orientation. However, a study conducted by Barry and Stewart (1997) found that teams with too many extroverts would be a team with too many leaders, with no "followers" or non-leaders to fulfill other team tasks and obligations. They

discovered that as the number of extraverted team members increased, so did group effectiveness. However, as the number of extraverted team members continued to increase to the point of comprising most of the team, group effectiveness declined.

Factoring in the research cited above, it seems logical that highly extraverted individuals would be more inclined to place themselves in leadership positions regardless of functioning through their desire for power and control or through their desire to interact with and help others. The notion that extraverts are more likely be dominant and lead is demonstrated in the work of Nicol and France (2016) which found evidence consistent with past research (Sibley & Duckitt, 2010) that extraversion significantly predicted social dominance orientation. This is most likely due to extreme extroverts being unreserved and willing to speak their mind, naturally lending to a position within a team's leadership.

Hypothesis 4: Extraversion will be positively related with sociability and dominance.

Agreeableness

Individuals who are high in agreeableness are perceived as generally friendly, flexible, cooperative, and considerate (Ciavarella et al., 2004). Agreeable team members are associated with greater levels of teamwork and tend to have higher quality interpersonal interactions (Le Pine & Van Dyne, 2001). This aligns with the team role dimension of sociability, with those individuals being characterized as interested in others, warm, cordial, etc. This is further reinforced by Huang and Ryan (2011) who found that agreeable people are associated with friendliness when interacting with others. It stands to reason that the more agreeable a person is, they are likely to be more sociable.

Though evidence suggests agreeableness may be a predictor of sociability, the relationship is more uncertain with task orientation. A study conducted by Jiang, Wang, and Zhou (2009) found that agreeableness had a negative predictive relationship with contextual performance. However, their experiment was conducted within a culture of high power distance. In fact, a meta-analysis by Barrick and Mount (1991) revealed that agreeableness is not an important predictor of job performance regardless of if the job was inherently social. As agreeableness may not predict job performance, it may not be associated with the descriptors of task orientation (e.g., planful, responsible, serious, etc.). However, low agreeableness is not necessarily indicative of low task orientation as behaviors such as careless, disordered, untrustworthy, and shy tend not to manifest under the agreeableness construct. These findings are inconsistent with the attributes that define task orientation.

This is in stark contrast to the dominance team role dimension, characterized by control, influence, assertiveness, etc. Everything known about agreeableness points toward the opposite, as those individuals high in agreeableness are less likely to engage in dominant behaviors. Agreeable people actively avoid violating traditional norms or upsetting people, falling more along the lines of conforming to social expectations as evidenced in Bègue et al. (2015) which identified that being highly agreeable can lead to destructive and immoral obedience. Since agreeableness is characterized by more passive behaviors, agreeable individuals will be more likely to let others take charge and control the group and its processes.

Hypothesis 5: Agreeableness will be positively related with sociability and negatively related with dominance.

Emotional Stability

Team members low in emotional stability are marked by neuroticism, anger, and depression (Barrick & Mount, 1991; Zhao & Seibert, 2006). Team members low in emotional stability may inhibit the development and maintenance of supportive team environments. Individuals with low emotional stability also tend to prohibit the formation and sustainment of supportive team environments as they do not work well with others. Ciavarella et al. (2004) demonstrated that individuals who are low in emotional stability are highly likely to be absent from or anxious during group interactions. This aligns with descriptors for low sociability, namely withdrawn, avoids contact with others, and solitary. On the other end of the spectrum, high emotional stability has been shown to aid in the ability to maintain relationships (Hurtz & Donovan, 2000). In addition, within team settings, being emotionally stable, confident, and calm are fundamental characteristics for maintaining a cohesive work environment, with the characteristics manifesting more in individuals scoring higher on emotional stability (Zhao & Seibert, 2006).

When individuals low in emotional stability are present for group meetings or other interactions, they tend to limit contextual performance, particularly voice behavior (Le Pine & Van Dyne, 2001). As voice behavior can involve implicit or explicit criticisms of the status quo (Detert & Burris, 2007), individuals with low emotional stability will be less likely to speak out if they disagree with something or give criticism regarding the team's processes. Some aspects of being emotionally unstable in social situations may also spill over into one's task orientation. Generally, being consistently absent or anxious and unwilling to help within team environments can be severely detrimental to team processes and outcomes.

As evidenced previously, individuals with low emotional stability are less likely to have positive interactions with team members and less likely to speak up and voice their concerns. They will be more likely to be absent or anxious, prohibiting normal group development. These qualities are in severe contrast with aspects of dominance (e.g., possessing influence, commanding others, being an active member of the team, etc.), making it unlikely that emotionally unstable individuals will be dominant within a team. Additionally, a study conducted by Scotter, Šillers, and Reņģe (2011) found a moderately negative correlation between task dominance and neuroticism, implying that individuals low in neuroticism are more likely to be dominant within team settings.

Hypothesis 6: Emotional Stability will be positively related with sociability, dominance, and task orientation.

CHAPTER THREE: METHODOLOGY

Sample

The data on which this study is based was drawn from NASA's Human Exploration Research Analog (HERA). HERA represents an isolated, confined environment whereby four-member crews engage in a simulated 2-year exploration mission. This mission is simulated over the course of 14, 30, or 45 days during which members engage in mission-relevant tasks (e.g., rover assembly, emergency simulation) and are isolated from friends, family, and coworkers. The data for the current effort is based in a subset of data obtained from 3 campaigns comprised of four to five separate missions each, for a total of 16 crew members in campaign 2 and 3 (four teams each), and 20 crew members in campaign 4 (five teams). Looking across all three campaigns, this provides a total data set of 52 crew members (13 teams).

Crew members were selected to be 'astronaut like', as such participants were 57.14% males, with ages ranging from 27 to 54 (M = 34.36). The sample predominantly consisted of Caucasians at 67.86%, followed by Hispanics (10.71%), Indians (10.71%), Asians (7.14%), and African Americans (3.57%). Additionally, every participant minimally possessed a bachelor's degree, with 46% in the field of Aerospace Engineering, with other hard-science fields (e.g., microbiology, medicine, etc.) represented as well.

Hypothesis 1 was analyzed at the team level, using data from 32 individuals across 8 teams. Hypotheses 2 through 6 were analyzed at an individual level, using data from 36 individuals across 9 teams. Specifically, Hypothesis 1 was tested using data from Campaigns 2 and 3, while the remaining hypotheses were tested using data from Campaigns 3 and 4. All hypothesized constructs were not able to be collected across all Campaigns, given the nature of the environment.

Measures

Mumford Team Roles Measure

To determine which team members were enacting roles, a 30-item survey developed by Mumford et al. (2008) was used, with 3 questions per role. This survey was adapted from a traditional Likert format to one that facilitated an analysis of role distribution. Specifically, each question asked participants whether their teammates (including themselves) enacted certain role behaviors on a binary scale (i.e., they either did or did not enact the behavior). Sample items include "Takes personal responsibility for getting the work done" and "Listens carefully to the thoughts and feeling of others." While this survey was administered at multiple points throughout the analog, for the purposes of this thesis (and the corresponding hypotheses) the mean level of role distribution across the course of the mission is computed for use in analyses.

Team Effectiveness

To determine the extent to which teams believed their efforts to be effective was a 3-item survey from Michigan State University (MSU). The survey asked participants about what happened during the day and the extent to which it happened on a 1-7 scale from 'Not at All' to 'To a Very Great Extent' (α = .85 - .97). The items on the survey are as follows: "To what extent did your crew accomplish your primary goals today?", "To what extent were the important tasks for today done with a high quality and timely fashion?", and "Taking everything into consideration, to what extent did your crew perform well today?" This survey was administered at multiple points in time throughout the analog; however, for the purposes of this thesis (and the corresponding hypotheses) the mean level of team effectiveness across the course of the mission is computed for use in analyses.

TRIAD

Next, measuring team role sub-dimensions is the TRIAD survey developed by Driskell et al. (2017). The survey has nine items, with three questions representing each team role sub-dimension of sociability ($\alpha = .992$), task orientation ($\alpha = .980$), and dominance ($\alpha = .991$). Participants rated themselves in addition to their teammates, for a total of 36 questions per participant, and were asked to rate the degree to which everyone enacted specific behaviors during team tasks. The scale represents a 7-point spectrum, with each end being indicative of specific behaviors. A sample item includes "Directs Activities vs. Follows Directions", such that a 1 would indicate an individual who purely directs activities and a 7 would indicate an individual who purely follows directions. This survey was also administered at multiple points throughout the duration of the analog.

Personality

Each participant was given a version of NEO to complete during each crew's training (two weeks before entering HERA) to assess each crew member's personality profile based on the Big 5 facets of personality (Costa & McCrae, 1992). Participants in Campaign 3 were given the NEO FFI-3 to assess their personality. This version of the NEO has 60 questions, with 12 representing the personality constructs of openness to experience, conscientiousness, extraversion, agreeableness, and emotional stability ($\alpha = .784$). Participants in Campaign 4 were given the IPIP-NEO-120 to assess their personality. This version of the NEO has 120 questions, with 24 representing the aforementioned personality constructs ($\alpha = .742$). Additionally, this version of the NEO also measures the personality constructs at the facet level. In order to combine the scores for use in analyses, z-scores were generated from the results of both versions

of the survey derived from their respective descriptive statistics from the total scores of each personality construct.

Analyses

To test the predictions set forth in Hypothesis 1, role density was calculated for the set of task roles and social roles. This process involved using the density approach of Carson, Tesluk, and Marrone (2007), whereby the total amount of role behaviors displayed by team members as perceived by others on the team is summed and then divided by the total number of possible ties among team members. Role density was then correlated with team effectiveness to determine if distributing roles leads to more effective teams. To further understanding about the relationship of specific task and social roles, exploratory analyses examined the degree to which distributing specific task and social roles was related to team effectiveness. For the remainder of Hypotheses 2 through 6, separate regressions were conducted to determine the extent to which each of the Big 5 personality dimensions predicts the enactment of team role sub-dimensions (i.e., sociability, task orientation, and dominance). All hypotheses were tested using one-tailed significance tests.

Given the small sample sizes involved in all analyses conducted, the results section will not only interpret the statistical significance of each analyzed effect, but also the strength of the effect with regard to the benchmarks of Cohen (1969). This work states that effect sizes of 0.1 are ‘small’ and hardly perceptible, 0.3 as ‘medium’ and big enough to be noticeable, and 0.5 as ‘large’ and easily perceptible. It is important to discuss the magnitude of effect sizes when discussing statistical significance (especially with small sample sizes; Fan & Konold, 2010), as measures of statistical significance take into consideration both effect size and sample size (Coe,

2002). Given a large enough sample size with little to no effect size, analyses may easily achieve significance, and as such data with a large enough effect size and a small sample size may easily achieve significance. This is why it is important to consider both effect size and sample size, and why I will discuss each effect size in the results section given that the sample overall was small.

CHAPTER FOUR: RESULTS

Hypothesis 1 predicted that team role distribution would be positively related to ratings of team effectiveness. To test this relationship, two Pearson correlations were run; one between overall task and social role density and team effectiveness, and a second exploratory analysis examining specific task role density and team effectiveness. Results of the overall task and social role density indicated a significant correlation between task role density and team effectiveness ($r(6) = .676$, $p = .033$), but a nonsignificant relationship between social role density and team effectiveness ($r(6) = .443$, $p = .136$). To further examine the relationship between task roles and team effectiveness, an exploratory 1-tailed Pearson correlation was conducted between each individual task role (Mumford et al., 2006) and team effectiveness. The task roles of Critic ($r(6) = .687$, $p = .030$) and Completer ($r(6) = .683$, $p = .031$) were found to produce a medium to large effect size (Cohen, 1969), being significantly correlated with team effectiveness. The remaining task roles were not significantly correlated with team effectiveness (Contributor: $r(6) = .599$, $p = .058$; Contractor: $r(6) = .532$, $p = .087$; Creator: $r(6) = .407$, $p = .159$). Of note is that all effect sizes were above or approaching the range for large effect sizes, with the Contributor ($p = .058$) and Contractor ($p = .087$) roles approaching significance despite the small sample size.

Hypothesis 2 predicted that openness to experience would have a positive relationship with the team role sub-dimensions of sociability and task orientation. Results did not provide support for hypothesis 2, in that openness to experience was not significantly related to either sociability ($F(1, 33) = 1.563$; $p = .110$) or task orientation ($F(1, 33) = .077$; $p = .392$). While hypothesis 2 was not supported, trends indicated that the relationships between openness to experience and sociability ($\beta = .213$), and openness to experience and task orientation ($\beta = .048$) were in the predicted directions. Additionally, the relationship between openness to experience

and sociability (β = .213) was indicative of a moderately small effect size, while the effect size for the relationship between openness to experience and task orientation (β = .048) was much weaker, falling below the 0.1 cutoff for small effect sizes. This indicates openness to experience may in part be predicting an individual's propensity for being sociable, but much less so for being task oriented.

Hypothesis 3 predicted that conscientiousness would have a positive relationship with the team role sub-dimensions of sociability and task orientation, and a negative relationship with dominance. Results did not support hypothesis 3 in that conscientiousness was not significantly related to sociability (F(1, 33) = 1.425, p = .121), task orientation (F(1, 33) = 1.145, p = .146), or dominance (F(1, 33) = .984, p = .191). While hypothesis 3 was not supported, trends were in the predicted direction: sociability (β = .203), task orientation (β = .183), and dominance (β = -.170) were in the predicted direction. Additionally, the three effect sizes were categorized as small (Cohen, 1969), with sociability being the strongest of the three.

Hypothesis 4 predicted that extraversion would have a positive relationship with the team role sub-dimensions of sociability and dominance. Hypothesis 4 was partially supported in that results indicated a significant positive relationship between extraversion and sociability (F(1, 33) = 7.909, R^2 = .193, β = .440, p = .004). However, extraversion was not significantly related to dominance, although trends were in the predicted direction (F(1, 33) = 2.647; p = .057; β = .272). The effect size for extraversion and sociability (β = .440) was found to be of medium strength, but approaching the 0.5 cutoff for a large effect size, providing a strong case for the relationship if the sample size were larger. Even the effect size for extraversion and dominance

(β = .272) was approaching the 0.3 cutoff for a medium effect size, suggesting that it may in part be influencing an individual's enactment of dominance behaviors.

Hypothesis 5 predicted that agreeableness would have a positive relationship with sociability and a negative relationship with dominance. The results for neither sociability (F(1, 33) = 2.575; p = .059) nor dominance (F(1, 33) = .000; p = .498) were significant, therefore Hypothesis 5 was not supported. As with many of the prior hypotheses, results trended toward the predicted direction for agreeableness and sociability (β = .269), however this was not the case with agreeableness and dominance (β = .001). While only the results for agreeableness and sociability were in the predicted direction, the effect size (β = .269) was approaching the cutoff for an effect size of medium strength (i.e., 0.3, Cohen, 1969), suggesting agreeableness may in part be influencing the enactment of sociable behaviors. The effect size for agreeableness and dominance (β = .001) was well below the cutoff for a small effect size, indicating no perceptible difference between scores.

Hypothesis 6 predicted that emotional stability would have a positive relationship with sociability, task orientation, and dominance. Hypothesis 6 was partially supported. As predicted, there was a significant positive relationship between emotional stability and sociability (F(1, 33) = 3.330, R^2 = .092, β = -.303, p = .039). However, the results were not significant for either emotional stability and task orientation (F(1, 33) = .032; p = .430) or emotional stability and dominance (F(1,33) = .089; p = .384). Once again, for the portion of the hypothesis which was not supported, results trended in the predicted direction (i.e., emotional stability and sociability, β = -.303; emotional stability and task orientation, β = -.031). Despite the effect sizes (β) being negative, the hypothesis is still partially supported due to the personality inventories measuring

the construct as “neuroticism”, whereas it was conceptualized as “emotional stability” in this thesis. For example, a negative relationship indicates that an individual with low neuroticism (or high emotional stability) would be more likely to exhibit higher levels of sociability. Additionally, the effect size for emotional stability and sociability were of medium strength, demonstrating the extent to which emotional stability may facilitate the enactment of sociable behaviors. However, the effect sizes for emotional stability and task orientation (β = -.031), and emotional stability and dominance (β = .052) were below the 0.1 cutoff for small effect sizes.

CHAPTER FIVE: DISCUSSION

The purpose of this thesis was to begin to examine the relationships within an analog that mimics many of the conditions of spaceflight (e.g., isolation, confinement, task types, stressors, etc.) in order to develop in-flight countermeasures to identify gaps in team functioning. As evidenced earlier in Chapter Two, team roles represent important coordinative mechanisms whereby team members fulfill duties required of them according to a particular expertise they may possess. While some teams may have formally assigned roles, such as the 'leader', there still remains many task and social functions of teamwork which would be impossible for one designated person to complete. For this reason, team role distribution was examined to determine the extent to which it is related to team effectiveness.

For all analyses, I chose to emphasize not only the statistical significance, but also the effect size of each relationship. Testing significance using p-values takes into account both effect size and sample size. As such, with a large enough sample, virtually any difference among sample means can be shown to be statistically significant. This is why it is important to also take into consideration the effect size. In this study, standardized β coefficients were reported as effect size, as the statistic is derived in the same manner as Cohen's *d* (Cohen, 1969). In accordance with Cohen's (1969) benchmarks for effect sizes (small = .10, medium = .30, large = .50), many of the results were in the medium to large range, being 0.3 or greater. Given the magnitude of the effect sizes, but abundance of non-significant results, GPower analyses were conducted for the team-level (1) and individual-level (2 - 6) hypotheses to see the likelihood that the reported results would have been significant given an adequate sample size. For the team-level hypothesis (1), an N of 13 would be necessary to achieve significance between each task role, indicating that data from at least 5 more HERA teams would need to be gathered, as will

happen over the next year and a half. For the individual-level hypotheses (2 - 6), an N of between 80 and 150 would be necessary to achieve statistical significance. These required sample sizes are not unreasonably large and provide further confidence in the notion that with a slightly larger sample size, many of the positive trends evidenced would translate into significant findings. This, in turn, suggests additional investigation of the reported relationships might be promising to pursue.

Broadly, task role distribution was found to be significantly correlated with team effectiveness. At the individual role-level, two task roles (i.e., Completer and Critic) were specifically found to be correlated with ratings of team effectiveness. Additionally, the effect size for each task role was found to be medium to large, approaching or surpassing the 0.5 cutoff for large effect sizes (β = .407 - .687). These effect sizes could be practically significant, as the small sample size (N = 8) would severely hinder their ability to achieve significance while not necessarily invalidating these large effect sizes (Coe, 2002).

While knowledge of how team roles enable teams to be more effective is important in understanding the dynamics of spaceflight teams, it would be beneficial to know who would be likely to enact particular roles. To test this relationship, personality was examined as a facilitator to the enactment of team roles by determining the extent to which the Big 5 personality constructs predicted levels of team role sub-dimensions. While only two of the predicted relationships were found to be significant (extraversion with sociability, and emotional stability with sociability), most of the relationships were in the correct predicted direction (i.e., positive or negative). Despite the abundance of non-significance, the magnitude of the effect sizes was examined with many relationships found to exhibit an effect size around the 0.3 medium cutoff range (β = .183 - .440). These results are promising as they show, to some extent, that

personality characteristics might be capable of predicting team role sub-dimension enactment and subsequently, the enactment of specific team role functions.

Implications

Regarding theoretical implications, the work conducted in this thesis begins to examine team roles within the context of spaceflight. In past works, team roles have been examined within "traditional" work settings, such as organizational or project teams. The constructs examined within this thesis begin to look at "non-traditional" teams, such that the teams were subject to conditions which mimic those of spaceflight (e.g., isolation, confinement, no chance for escape, etc.). These types of conditions and stressors are not typically faced by ordinary teams, giving us a glimpse of how team roles function in such a unique environment. Additionally, the examination of the relationship between the Big 5 personality constructs and the enactment of team role sub-dimensions provides a conceptually interesting look into how personality might predict the enactment of team roles. As will be mentioned in the next section, an increased sample size could significantly increase prediction power, enabling for the construction of more well-balanced teams in spaceflight.

Regarding practical implications, sociability was found to be predicted by both extraversion and emotional stability. When selecting individuals to embark on spaceflight missions, it could be potentially beneficial to pay close attention to scores on those two personality constructs; results indicated that these two constructs significantly predicted the enactment of the sociability team role sub-dimension. As astronauts will be extremely confined around their peers, the enactment of sociability could prove greatly beneficial, as evidenced by certain social roles being significantly correlated with ratings of team effectiveness. As such,

selecting individuals who are more extraverted and emotionally stable could potentially increase the extent to which a team would be effective.

Limitations

Perhaps the most significant limitation to this research is the sample size. As HERA participants are selected to be as 'astronaut-like' as possible, this severely limits the pool from which participants may be selected. Additionally, participants must be willing to dedicate 14, 30, or 45 days (mission-dependent) away from their own work to participate in research, which can be incredibly difficult, if not impossible, for some individuals. While such restrictions are understandably necessary to select astronaut-like candidates to participate in HERA, these criteria do place an incredible filter on potential participants who would be willing and able to participate in the analog.

Another limiting factor to this study is the selection criteria imposed in order to comprise teams who are 'astronaut-like' which may have led to range restriction on some of the key personality variables examined. For example, nearly all participants (89%) had advanced degrees (Master's or Ph.D.) with most having degrees in the hard sciences. The selection criteria combined with the voluntary nature of the study may had led to a restricted range on some of the personality constructs of interest. For example, it might be expected that due to a willingness to be confined within an analog constructed to mimic some of the conditions of long duration exploration missions with a set of complete strangers for up to 45 days, individual crew members might score high on openness to experience, extraversion, and agreeableness. The obtainment of advanced degrees, mostly in the hard sciences could produce restricted range on personality constructs such as conscientiousness. While an examination of the data indicated that variance

did exist across participants on key personality variables, the range was restricted with many individuals scoring on the higher end of the scale.

Additionally, it was not possible to fully examine the predictive ability of the personality dimensions of the Big 5 at the sub-facet level, as participants across the two examined Campaigns took two different versions of the NEO: one with the constructs at the sub-facet level and one without, determining the extent to which each of the broad Big 5 constructs is comprised of more specific functions (e.g., extraversion being comprised of friendliness, gregariousness, assertiveness, activity level, excitement-seeking, and cheerfulness). Examining personality at the sub-facet level would allow an even more nuanced look at exactly which behaviors are driving the enactment of team role sub-dimensions and subsequent team role functions.

Future Directions

As a next step, the team roles identified by Burke et al. (2017) will be analyzed with the TRIAD sub-dimensions, assessing the extent to which each role is comprised of each dimension. As an extension of this work, the relationship between the roles and the personality constructs will be examined to see if a stronger link is not provided. Another variable to examine is the contextual factors at play which may affect team members' enactment of team roles. While the HERA environment is designed to simulate space flight as much as possible, there still may be some factors which impact participants' reactions to the research analog. While participants are subject to such events as sleep deprivation and fluctuations in autonomy similar to astronauts in space, there could be other events not yet accounted for which would affect the fidelity of the environment (e.g., no sense of danger analogous to real space flight).

Additionally, it was not possible within the scope of this thesis to examine the extent to which the personality constructs of openness to experience, conscientiousness, extraversion, agreeableness, and emotional stability predict enactment of team role sub-dimensions at the facet level. In the IPIP-NEO-120, each personality construct is comprised of six facets. Examining the predictive ability of the individual facets might be more diagnostic of individual tendencies indicative of team role sub-dimension enactment. Lastly, while not within the scope of this thesis, temporal dynamics will be examined to determine the effects of time on each of these variables. Additionally, some HERA participants were consistent in their ratings across days, while others varied from day to day. This could provide initial evidence that time plays a factor in the emergence of team role sub-dimensions. To truly ensure that there will be no gaps in team functioning on such a mission, it will be crucial to see how these team dynamics play out over an extended period of time.

APPENDIX A: SURVEYS

Team Role Test

Mumford, T. V., Van Iddekinge, C. H., Morgeson, F. P., & Campion, F. P. (2008). The team role test: Development and validation of a team role knowledge situational judgment test. *Journal of Applied Psychology*, *93*(2), 250-267.

Below are a list of actions that may occur within teams. Please indicate who on your team engaged in each action. There are no right or wrong answers and multiple people may be checked for a single behavior.

	Commander	Flight Engineer	Mission Specialist 1	Mission Specialist 2
Organizes the team's work to get important work done on time	☐	☐	☐	☐
Coordinates the work done by others so that things are done in the right order	☐	☐	☐	☐
Helps the team focus on getting the job done efficiently	☐	☐	☐	☐
Suggests creative ways to solve the team's problems	☐	☐	☐	☐
Helps the team take a fresh perspective on problems	☐	☐	☐	☐
Sees the "big picture" and has creative ideas for handling problems	☐	☐	☐	☐
Speaks out when he/she knows the most about the work to be done	☐	☐	☐	☐
Shares with the team any knowledge he/she has about the work to be done	☐	☐	☐	☐
Takes the lead in the team when he/she has a lot of experience in that area of work	☐	☐	☐	☐
Takes personal responsibility for getting the work done	☐	☐	☐	☐
Finishes work for the team on time without being reminded	☐	☐	☐	☐
Follows through on commitments made to the team	☐	☐	☐	☐
Speaks up if he/she has concerns with the work the team is doing	☐	☐	☐	☐

Makes sure the team talks about both positive and negative consequences of decisions	☐	☐	☐	☐
Shares honest opinions about how the team is working, even if the opinion is not favorable	☐	☐	☐	☐
Supports the team and its goals after having given input, even if he/she would have personally set different goals	☐	☐	☐	☐

	Commander	Flight Engineer	Mission Specialist 1	Mission Specialist 2
Admits when others have more experience in particular areas and trusts their judgment	☐	☐	☐	☐
Recognizes the expertise of others and allows them to take a leadership role in the team	☐	☐	☐	☐
Makes the work pleasant and comfortable by being happy and easy to work with	☐	☐	☐	☐
Communicates personal feelings and thoughts respectfully and without offending anyone	☐	☐	☐	☐
Listens carefully to the thoughts and feelings of others	☐	☐	☐	☐
Helps settle conflicts between members of the team	☐	☐	☐	☐
Suggests positive ways for the team to interact such as taking turns, showing respect, and being open to new ideas	☐	☐	☐	☐
Steps in if there are negative feelings in the team to help resolve the difficulties	☐	☐	☐	☐
Goes outside the team to bring in new resources that help the team work effectively	☐	☐	☐	☐
Gets information from sources outside the team before making an important decision	☐	☐	☐	☐
Interacts with people outside the team to get special knowledge about the work, the product, customers or management	☐	☐	☐	☐
Tells the supervisors and managers favorable information about the team and its goals	☐	☐	☐	☐
Gets support for the team with important people outside the team such as supervisors and managers	☐	☐	☐	☐
Tries to provide supervisors and managers with frequent updates about the team's accomplishments	☐	☐	☐	☐

IPIP-NEO-120

Costa, P. T., & McCrae, R. R. (1992). Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychological assessment*, *4*(1), 5.

The following pages contain phrases describing people's behaviors. Please use the rating scale next to each phrase to describe how accurately each statement describes you. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then click the circle that corresponds to the accuracy of the statement.

Very Inaccurate
|
Moderately Inaccurate
|
Neither Accurate nor Inaccurate
|
Moderately Accurate
|
Very Accurate

1. Worry about things.
2. Fear for the worst.
3. Am afraid of many things.
4. Get stressed out easily.
5. Get angry easily.
6. Get irritated easily.
7. Lose my temper.
8. Am not easily annoyed.
9. Often feel blue.
10. Dislike myself.
11. Am often down in the dumps.
12. Feel comfortable with myself.
13. Find it difficult to approach others.
14. Am afraid to draw attention to myself.
15. Only feel comfortable with friends.
16. Am not bothered by difficult social situations.
17. Go on binges.
18. Rarely overindulge.
19. Easily resist temptations.
20. Am able to control my cravings.

21. Panic easily.
22. Become overwhelmed by events.
23. Feel that I'm unable to deal with things.
24. Remain calm under pressure.
25. Make friends easily.
26. Feel comfortable around people.
27. Avoid contacts with others.
28. Keep others at a distance.
29. Love large parties.
30. Talk to a lot of different people at parties.
31. Prefer to be alone.
32. Avoid crowds.
33. Take charge.
34. Try to lead others.
35. Take control of things.
36. Wait for others to lead the way.
37. Am always busy.
38. Am always on the go.
39. Do a lot in my spare time.
40. Like to take it easy.
41. Love excitement.
42. Seek adventure.
43. Enjoy being reckless.
44. Act wild and crazy.
45. Radiate joy.
46. Have a lot of fun.
47. Love life.
48. Look at the bright side of life.
49. Have a vivid imagination.
50. Enjoy wild flights of fantasy.
51. Love to daydream.
52. Like to get lost in thought.
53. Believe in the importance of art.
54. See beauty in things that others might not notice.
55. Do not like poetry.
56. Do not enjoy going to art museums.
57. Experience my emotions intensely.
58. Feel others' emotions.
59. Rarely notice my emotional reactions.
60. Don't understand people who get emotional.
61. Prefer variety to routine.

62. Prefer to stick with things that I know.
63. Dislike changes.
64. Am attached to conventional ways.
65. Love to read challenging material.
66. Avoid philosophical discussions.
67. Have difficulty understanding abstract ideas.
68. Am not interested in theoretical discussions.
69. Tend to vote for liberal political candidates.
70. Believe that there is no absolute right and wrong.
71. Tend to vote for conservative political candidates.
72. Believe that we should be tough on crime.
73. Trust others.
74. Believe that others have good intentions.
75. Trust what people say.
76. Distrust people.
77. Use others for my own ends.
78. Cheat to get ahead.
79. Take advantage of others.
80. Obstruct others' plans.
81. Am concerned about others.
82. Love to help others.
83. Am indifferent to the feelings of others.
84. Take no time for others.
85. Love a good fight.
86. Yell at people.
87. Insult people.
88. Get back at others.
89. Believe that I am better than others.
90. Think highly of myself.
91. Have a high opinion of myself.
92. Boast about my virtues.
93. Sympathize with the homeless.
94. Feel sympathy for those who are worse off than myself.
95. Am not interested in other people's problems.
96. Try not to think about the needy.
97. Complete tasks successfully.
98. Excel in what I do.
99. Handle tasks smoothly.
100. Know how to get things done.

101. Like to tidy up.
102. Often forget to put things back in their proper place.
103. Leave a mess in my room.
104. Leave my belongings around.
105. Keep my promises.
106. Tell the truth.
107. Break rules.
108. Break my promises.
109. Do more than what's expected of me.
110. Work hard.
111. Put little time and effort into my work.
112. Do just enough work to get by.
113. Am always prepared.
114. Carry out my plans.
115. Waste my time.
116. Have difficulty starting tasks.
117. Jump into things without thinking.
118. Make rash decisions.
119. Rush into things.
120. Act without thinking.

TRIAD

Driskell, T., Driskell, J. E., Burke, C. S., & Salas, E. (2017). Team roles: A review and integration. *Small Group Research*, *48*(4), 482-511.

On the following items, please rate the degree to which you and your teammates may have exhibited the following behaviors during the tasks completed today.

	Takes a **leading role** in group interaction						Takes a **supporting role** in group interaction
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Directs Activities						**Follows Direction**
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Dominant Behavior						**Passive Behavior**
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Friendly						**Unfriendly**
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Warm						Cold
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Interested in Others						Aloof
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Hard-Working						Shy
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Focused on the Task						Unfocused
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

	Conscientious						Careless
	1	2	3	4	5	6	7
Yourself	○	○	○	○	○	○	○
FE	○	○	○	○	○	○	○
MS1	○	○	○	○	○	○	○
MS2	○	○	○	○	○	○	○

APPENDIX B: IRB APPROVAL

IRB Approval

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Shawn Burke** and Co-PI: **Stephen M. Fiore**

Date: **June 15, 2018**

Dear Researcher:

On 06/15/2018 the IRB approved the following human participant research until 06/14/2019 inclusive:

Type of Review:	IRB Continuing Review Application Form Expedited Review
Project Title:	Dynamic Team Role Allocation in Long Duration, Exploration Missions: Identification of Roles, Triggers, and Measurement Tools (HERA)
Investigator:	Shawn Burke
IRB Number:	SBE-14-10596
Funding Agency:	NASA
Grant Title:	
Research ID:	1059370

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at https://iris.research.ucf.edu .

If continuing review approval is not granted before the expiration date of 06/14/2019, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a signed and dated copy of the consent form(s).

All data, including signed consent forms if applicable, must be retained and secured per protocol for a minimum of five years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained and secured per protocol. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

This letter is signed by:

Signature applied by Gillian Morien on 06/15/2018 12:42:40 PM EDT

Designated Reviewer

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